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Biological Half-Life of Tritium in Chickens and Eggs

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Contact: A. L. Mullen, 8-595-2969, ext. 281 (Las Vegas, NV)

16. ABSTRACT

Previous studies of tritium transport in the environment suggest that although water is the main route for human intake, other routes should not be ignored. The importance of eggs as a step in the pathway for human intake of tritium was assessed by intravenously administering a single dose of tritiated water to 50 white Leghorn laying hens. Blood samples and eggs were collected from the hens for the next 17 days. The eggs were separated into the yolk and white portions and all samples were analyzed for both free water and organically bound tritium.

Tritium in the blood decreased with a 4.60 ± 0.26 day half-life. No significant differences were observed for the tritiated free water obtained from the white or yolk portion of the eggs. The peak activity in eggs occurred one day following administration and decreased with an average half-life of 3.65 ± 0.26 days. Tritium incorporated into the organic components of egg white and yolk reached peak levels of activity at six and eight days respectively and then decreased with essentially the same half-life as the free water portion.

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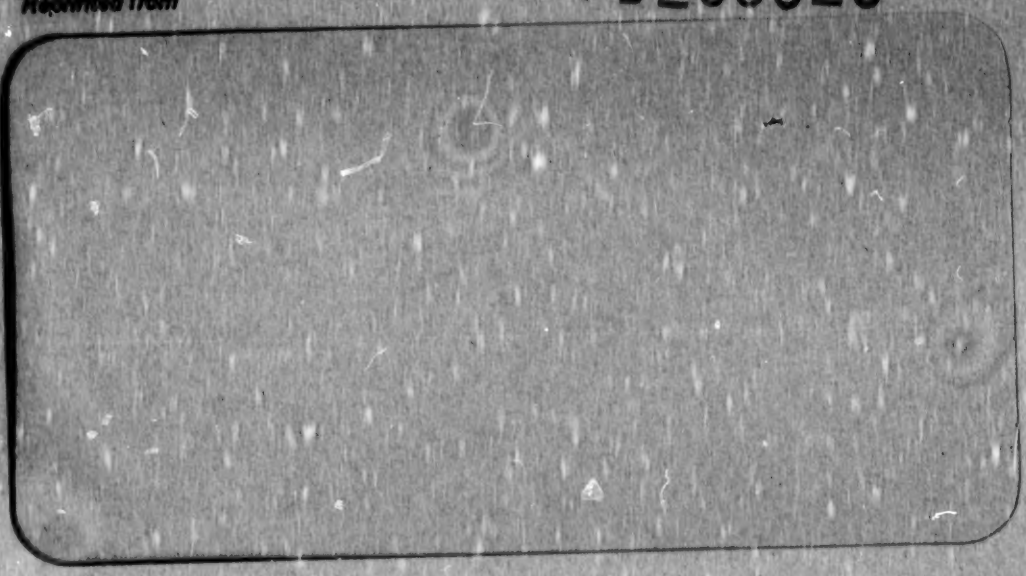

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Biological Half-Life of Tritium in Chickens and Eggs

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LITTLE is known of the metabolism of tritium by *Gallus domesticus* and its subsequent transfer to eggs. Tritium is a by-product of nuclear technology. With increased demand for energy supplied by nuclear power, an increase in associated processing plants will also occur. The greater the number of sources for the release of tritium the greater will be the potential for contamination of the environment, including farm areas. In this event, chickens allowed to forage around farmyards may ingest contaminated water or feedstuffs. This ingested tritium may be transferred to eggs.

Previous studies of tritium transport in the environment suggest that although water is the main route for human intake, other routes should not be ignored, particularly those in the direct human food chain.

Procedure

A single 25-μCi dose of an isotonic tritium solution was intravenously administered into the wing vein of 50 white Leghorn laying hens. The hens were confined in individual cages allowing free access to water and pelleted feed from individual containers. The eggs were collected twice daily from the floor of the cage. The whites and yolks were separated, weighed and placed in glass sample bottles. Blood samples were collected hourly for the first 4 hr after dosing, then at increasing time intervals over the next 17 days. The blood was obtained by means of cardiac puncture. As this is a stressful procedure which on occasion resulted in mortality, each blood datum point represents the average of the tritium activity in the blood of three hens selected at random from the flock.

All samples were immediately covered with a layer of benzene and capped tightly to retard the evaporation of moisture prior to analysis. The quantitative separation of free water from these samples was accomplished by the azeotropic distillation technique developed by MOGHISSI *et al.* (1973). The tritium content of the aqueous phase was determined by liquid scintillation counting.

The organically bound tritium in the egg portions was separated from the organic residue following the azeotropic distillation by combustion in a Parr bomb. The water of combustion was collected and the tritium content determined by liquid scintillation counting.

Results

As shown in Fig. 1, the tritium content in the free water of the blood decreased with a 4.60 $\pm$ 0.26 days half-life. This half-life is in good agreement with that found in other experimental animals. REHNBERG *et al.* (1972) found a half-life of 4.1 days for tritium turnover in rats following intravenous administration of tritiated water and according to POTTER *et al.* (1972) and KIRCHMANN *et al.* (1969) the range in lactating dairy cows is from 3 to 5 days. This implies that turnover of body water in laying hens is similar to that of mammalian animals.

As may be seen in the lower two graphs of Fig. 1, the tritiated free water obtained from the white and yolk portion of the eggs reached a maximum tritium activity 1–2 days after administration. Activity in

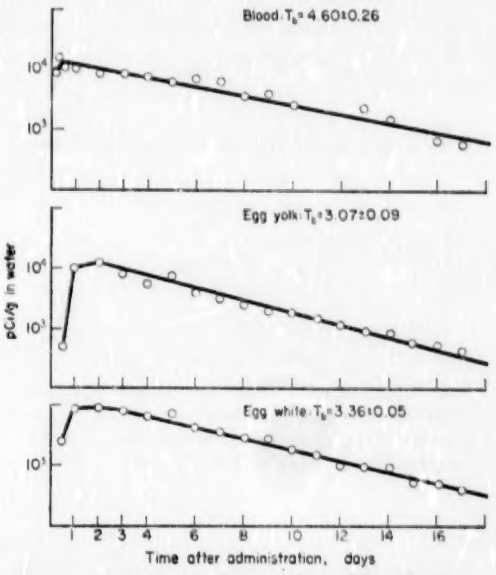
Blood: T_b = 4.60±0.26
Egg yolk: T_b = 3.07±0.09
Egg white: T_b = 3.36±0.05
pCi/g in water
10^4
10^3
1 2 3 4 6 8 10 12 14 16
Time after administration, days

FIG. 1. Average tritium concentration in the free water components of blood and eggs from chickens following a single intravenous administration of tritiated water.

both portions decreased with a half-life of about 3 days. Therefore, this intravenously administered tritium appears to have equilibrated throughout the body water of the hens within a relatively short period of time.

Tritium incorporated into the organic components of egg white and yolk is illustrated in Fig. 2. The peak activity increased slowly after 1 day with the maximum activity reached in the egg white at 4–6 days. The peak activity was delayed in the yolk until 8 days following dosing. The half-lives after the peak were similar.

As described by STURKIE (1970), the formation of an egg is quite a complicated process. The ovum (yolk) is layed down in layers over a period of 7–10 days. The albumen (white) is secreted around the yolk in a process that takes about 3 hr. The egg then passes on down the duct and the inner and outer shell membranes are formed in about 75 min. The egg then moves into the uterus or shell gland. This is the area where the water is added through the semipermeable shell membrane to the albumen and where the egg shell is deposited. The egg remains in the shell gland approx 18–20 hr, then passes to the vagina for laying. This explains the delay in reaching peak activity of organically bound tritium in the yolk until 8 days following administration.

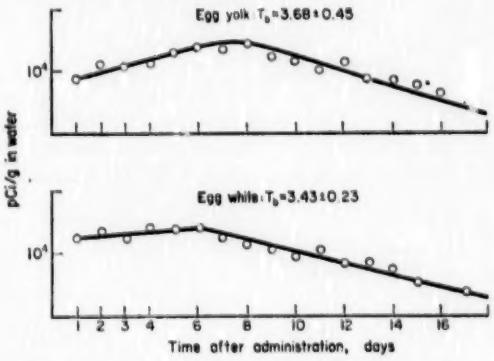

FIG. 2. Average tritium concentration in water obtained from combustion of the organic components of eggs from chickens following a single intravenous administration of tritiated water.

Assuming a 19-g egg yolk containing about 49% free water and a 34-g egg white containing about 88% free water one can apply the data on Fig. 1 and calculate that the eggs laid the second day after dosing contained an average of 1.7% of the dose per raw egg. If the average tritium activity found incorporated into the organic components is added to that in the free water the total tritium is about 2% of the amount of the administered dose per raw egg. If this raw egg is prepared in such a manner that the free water is driven off by heat, there would probably be much less tritium available for consumption. If eggs are the only source of tritium exposure, there would be little hazard. However, eggs should be considered as one of the sources when assessing the total tritium exposure to man.

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A. L. MULLEN
A. A. MOGHISSI*
R. E. STANLEY
S. R. LLOYD
P. A. FORT†

U.S. Environmental Protection Agency
Environmental Monitoring and Support Laboratory
Las Vegas, NV 89114

* *Georgia Institute of Technology*
Bioenvironmental Engineering Center
Atlanta, GA 30332

† *Clark County School District*
Las Vegas, NV 89114

References

KIRCHMANN R., LAFONTAINE A., VAN DER HOEK J. and KOCH G., 1969, *C.r. Stanc. Soc. Biol.* **163,** 1459.

MOGHISSI A. A., BRETTHAUER E. W. and COMPTON H. H., 1973, *Analyt. Chem.* **45,** 1565.

POTTER G. D., VATTUONE G. M. and MCINTYRE D. R., 1972, *Health Phys.* **22,** 405.

REHNBERG B. F., MOGHISSI A. A., WHEELER J. K. and COLVIN M. C., 1972, *Health Phys.* **22,** 31.

STURKIE P. D., 1970, *Dukes Physiology of Domestic Animals* (Edited by SWENSON M. J.), p. 526 (Ithaca, NY: Cornell Univ. Press).